Office of Operating Experience Analysis, EH-33 • U.S. Department of Energy • Washington, D.C. 20585

OPERATING EXPERIENCE WEEKLY SUMMARY

Office of Nuclear and Facility Safety

July 9 - July 15, 1999

Summary 99-28

Operating Experience Weekly Summary 99-28

July 9 - July 15, 1999

Table of Contents

Visit Our Website

The Weekly Summary is available, with word search capability, via the Internet at **http://tis.eh.doe.gov/web/oeaf/oe_weekly/oe_weekly.html**. If you have difficulty accessing the Weekly Summary at this URL, please contact the ES&H Information Center, 1(800) 473-4375, for assistance. If you have additional pertinent information or identify inaccurate statements in the summary, please bring this to the attention of Jim Snell, (301) 903-4094, or e-mail address jim.snell@eh.doe.gov, so we may issue a correction.

EVENTS

1. NEAR MISS WHEN BALL AND HOOK DROP FROM DRILL RIG BOOM

On July 4, 1999, at the Nevada Operations Office Project Shoal Area, a ball-and-hook assembly weighing approximately 100 lb fell from a drill rig boom and struck the top of the operator's control console. The accident occurred when an assistant to the derrick operator mistakenly raised a sand line hoist instead of a hose line hoist on a drill rig. The sound of the sand line ball two-blocking at the tip of the boom alerted the derrick operator and his assistant to imminent danger and they ran to the end of the drill platform. (Two-blocking is the contact of a hoist block or hook assembly with a boom tip.) The 5/8-in. sand line cable parted and the ball-and-hook assembly dropped approximately 63 ft to the console. This occurrence is significant because it could have involved serious injury or a fatality. (ORPS Report NVOO--INTV-INTV-1999-0002)

At the time of the occurrence, a drilling subcontractor was operating an LM 300 drill rig to install four deep monitor wells, ranging in depth from 1,300 to 4,000 ft. The wells are to supplement monitoring wells that were installed following a 1963 underground nuclear detonation at the Project Shoal Area. A drilling subcontractor crew consisting of a drill operator and his assistant, an operator trainee, were preparing to remove a drill rod from the borehole for one of the wells to check the bit for wear. A hose cylinder line on the drill rig mast was supporting the discharge line from the assembly to provide the clearance needed to remove the drill rod. The operator, who was handling the discharge line from the drill platform, instructed his assistant to raise the hose cylinder line. However, the assistant operated the lever for the idle sand line by mistake. The ball-and-hook assembly on the sand line contacted the boom tip and the resulting strain parted the cable. The operator and his assistant immediately cleared the area. The ball and hook glanced off support structure for the drill rig mast, struck the operator's console, and fell to the drill platform 6 ft from the console. The impact caused a depression of about 1 in. in the ¼-in. steel console cover (Figure 1-1).

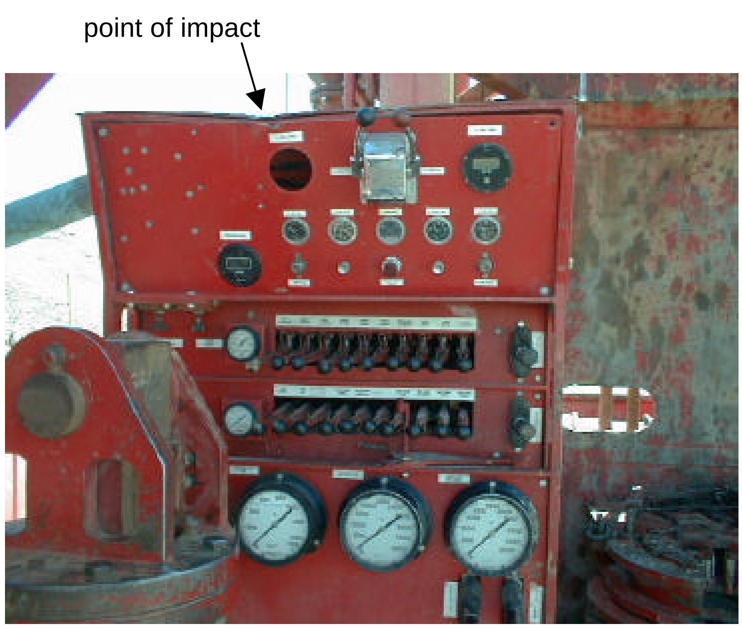

Figure 1-1. Damage to LM-300 Drill Rig Operator's Console

The site safety officer terminated the drilling operations and initiated an investigation of the occurrence. Investigators have been able to determine the following.

- The ball-and-hook assembly was approximately 20 ft from the boom tip before the occurrence. By the time it contacted the boom tip it was too late to stop the winch.

- The sand line is not equipped with a high-load cutout to prevent two-blocking.

- The sand line winch is rated for 10,000 lb, and the line pull rating of the cable is 31,200 lb. The cable failed because it had kinked as it passed through the sheave at the boom tip.

Site personnel have repaired and inspected the drill rig and returned it to service.

OEAF engineers searched the ORPS database for “Occurrence Description” containing “drill<SENTENCE>rig” and found 19 instances of employee injury or near misses and 9 instances of equipment failure. The following have elements in common with the occurrence at the Project Shoal Area.

- On October 21, 1996, at the Los Alamos Fenton Hill Geothermal Site, a drill rig floor hand was struck and injured by moving machinery during well service operations. A drill operator who intended to operate an upper tong inadvertently pulled a lever that operated the lower tong, which was not secured to the derrick leg with a safety chain. The action rotated the tong towards the floor hand, which struck him on the right leg below the kneecap and caused fractures of the fibula and tibia. (ORPS Report ALO-LA-LANL-FENTONHILL-1996-0002)

- On July 28, 1992, at the Yucca Mountain Project Division, 17 joints of a drill string fell 50 feet back into a hole from which an LM 300 drilling rig crew were removing it. Drill hands had unscrewed a joint of pipe as the string was being supported by a yoke. The operator had intended to raise the disconnected pipe, but instead operated the control lever for the yoke. The yoke retracted and dropped the string. Investigators identified inadequate man-machine interface as the root cause of the event. The design of the drill rig should not have allowed the yoke to be opened with the weight of a drill string on it. Also, because the LM 300 rig has two banks of closely spaced, nearly identical levers, operators have difficulty distinguishing between them. (ORPS Report HQ--RELV-LVOGD-1992-0003)

The use of drill rigs has increased significantly across the DOE complex over the past decade as the DOE mission began to incorporate site characterization and mitigation of the environmental effects of historical operations. The drill rigs in use vary in size and function, but all are intrinsically hazardous to operate. Drilling involves proximity of personnel to heavy equipment, suspended loads, and rotating equipment. Operations frequently are repetitive and monotonous. Drilling safety requires continuous safety awareness and attention to detail. The following is taken from the facility manager’s evaluation of the occurrence at the Fenton Hill Geothermal Site.

“The operation of this type of drill rig is inherently dangerous and will remain as such until the industry takes steps to update the machinery used and the standard work practices. The present machinery designs and methods result in numerous opportunities for failure, and the consequences of failure are very high. The industry generally accepts a higher level of risk than would normally be acceptable within the DOE complex. Additionally, this industry is specifically exempt from most of the OSHA safety and health regulations. The industry follows its own industry standards, and to some extent, these standards allow for a high level of risk to exist. The safe operation of a rig of this type is very dependent on the experience of the crew not only as individuals, but also as a team. Due to a decade-long industry slump, there is a limited pool of experienced drill hands.”

The occurrence at the Project Shoal Area underscores the importance of closely monitoring personnel under instruction. The competency of drill rig operators must be verified and trainers must be immediately available to correct errors. The qualified drilling operator became involved in work on the drill platform and did not monitor the actions of the operator in training. Further, both failed to recognize the effects of the trainee's actions until it was too late to correct them. Only the fact that drill rig operators are trained to react quickly to signs of trouble averted serious injury. Persons who conduct on-the-job training must understand that trainees cannot be permitted to perform tasks independently for which they are not fully qualified.

KEYWORDS: drill, hoist, industrial safety, near miss, training and qualifications

FUNCTIONAL AREAS: Hoisting and Rigging, Industrial Safety

2. ONE-TON TROLLEY ATTACHED TO A TWO-TON HOIST SYSTEM

On June 22, 1999, at the Pantex Plant, a system engineer performing a hoist configuration management walk-down discovered a trolley rated at 1 ton attached to a hoist system rated at 2 tons. The hoist and trolley were moved from an inactive facility approximately 5 years ago and were not altered during the move or since. Incorrectly rated capacity can result in overstressed equipment or a dropped load if the load exceeds the capacity of any component in the hoist system. (ORPS Report ALO-AO-MHSM-PANTEX-1999-0047)

Investigators determined that the hoist was never used to lift loads in excess of 1 ton in its present location. Facility personnel are required to perform a 3-year capacity check on the hoist. The 3-year capacity check requires testing the system at 125 percent of the rated load, so investigators believe that facility personnel tested the system using a load of 5,000 lb. Facility personnel also perform monthly preventive maintenance that requires them to check that the capacity of the hoist system is labeled at the load hook and bridge beam, but there was no requirement to check the capacity of the trolley. Investigators have been unable to determine why a 1-ton trolley was installed on a 2-ton hoist. The facility manager ordered that the trolley and hoist be replaced with 2-ton capacity units and has submitted a supplemental work order to check all hoists at Pantex for similar conditions.

NFS reported a similar event in Weekly Summary 97-13 in which engineering personnel at the Idaho Chemical Processing Plant discovered discrepancies between an equipment design drawing for a fuel handling cask lifting device and the in-field load capacity tags. The drawing indicated a lifting device design capacity of 15 tons and the in-field tags showed a capacity of 20 tons. Investigators reviewed the load-testing records for the lifting device and discovered it was last tested in 1993. Between 1985 and 1993, it had been tested to 150 percent of the capacity shown on in-field tags eight times. In fact, those test loads of 30 tons actually amounted to 200 percent of the 15-ton design capacity. (ORPS Report ID--LITC-FUELRCSTR-1997-0004)

These events illustrate the importance of having a thorough and disciplined configuration management program. Facility managers should ensure that all personnel are made aware of the need for modification reviews and for a stringent configuration management change control process. An adequate configuration control system would ensure that the rated capacity of hoisting and rigging systems is no more than the lowest rated component of the system.

DOE-STD-1090-96, *Hoisting and Rigging*, chapter 7, specifies operation, inspection, maintenance, and testing requirements for the use of overhead and gantry cranes and implements the requirements of ASME B30.2, *Overhead and Gantry Cranes*. These requirements are also outlined in 29 CFR 1910.179, *Overhead and Gantry Cranes.*

The following guidance from the Hoisting and Rigging standard applies to this event.

- Section 3.2.4, “Equipment/Rigging Selection,” recommends determining the type, class, and minimum capacity of lifting equipment (hoist, crane, forklift, etc.) required for the operation based on the identified load, task, and hazards.

- Section 7.1.2, “Rated Load Marking,” states that the rated capacity shall be marked on each side of the crane. If the crane has more than one hoisting unit, each hoist shall have its rated capacity marked on it or on its load block. Markings on the bridge, trolley, and load block shall be legible from the ground or floor.

- Section 7.1.3, “Modification,” states that cranes may be modified or rerated provided the modifications or supporting structures are analyzed thoroughly by a qualified engineer or by a manufacturer of cranes. A crane whose load-supporting components have been modified shall be tested in accordance with section 7.3, “Testing.”

- Section 7.1.9, “Maintenance History,” states that the maintenance history of the crane shall be retained throughout its service life.

Additional guidance related to this event can be found in the following references.

- DOE 5480.19, *Conduct of Operations Requirements for DOE Facilities*, chapter VIII, “Control of Equipment and System Status,” states that equipment and systems in a DOE facility must be properly controlled. DOE facilities are required to establish administrative control programs to handle configuration changes resulting from maintenance, modifications, and testing activities. Chapter XVIII, “Equipment and Piping Labeling,” states that labels should be consistent with the information contained in facility documentation. The chapter also addresses the verification of labels.

- DOE-STD-1073-93, *Guide for Operational Configuration Management Program Including the Adjunct Programs of Design Reconstitution and Material Condition and Aging Management*, states that walk-downs should be performed to verify that the actual physical configuration agrees with the configuration shown on the facility documentation. It discusses the control of modifications that can lead to temporary or permanent changes in design requirements, facility configuration, or facility documentation. The standard also discusses identifying changes, conducting technical and management reviews, and implementing and documenting changes.

KEYWORDS: configuration control, hoisting and rigging, inspection

FUNCTIONAL AREAS: Hoisting and Rigging, Industrial Safety

3. SPARK FROM METAL CUTTING OPERATION CAUSES FILTER FIRE

On July 7, 1999, at the Allied Technology Group (ATG) Catalytics facility at Oak Ridge, contract welders cutting 1-in.-thick carbon-steel shielding caused a fire in a local-area process ventilation roughing filter constructed of pleated paper. They were cutting and shaping the shielding with an oxyacetylene torch 10 to 12 ft above floor level and approximately 3 ft from a ventilation duct when they saw flames in the filter. Facility personnel secured all ventilation fans to prevent the fire from spreading and all unnecessary personnel evacuated the building. An ATG shielding-installation supervisor attempted to extinguish the fire by injecting carbon dioxide into the ventilation duct, but this was unsuccessful. The supervisor eventually smothered the fire by removing a metal inspection plate upstream of the filter and injecting a dry chemical fire-extinguishing agent into the duct. There was no damage to the facility. The workers had unknowingly violated facility procedures that prohibited cutting, grinding, or welding within 35 ft of combustible material. This event is significant because many DOE facilities have changed over to deactivation and decommissioning activities, which increases the volume of cutting and welding operations and the hazards associated with them. (NRC Event Report Number 35914)

This facility accepts highly radioactive spent resin from commercial nuclear power plants and reduces the volume of the resin by a heated, pressurized, catalytic conversion process that creates a solid matrix of material for disposal. The facility's radiation safety officer stated that the fire started when sparks from the cutting operation were sucked into the process filter through small holes in a ductwork seam that were not seen by the workers. Although the filter was slightly contaminated, local-area air monitors and stack samplers indicated that no radioactive release occurred, and personnel surveys indicated that no one was contaminated during the fire. The safety officer also said that facility managers prohibited any welding and cutting activity until all hot-work procedures were revised to clarify their safety requirements and the contract workers were retrained on the procedures. Additionally, facility supervisors will tour and inspect work sites prior to approving any hot-work permits and periodically when any cutting or welding operations are in progress.

A similar event also occurred recently at a commercial nuclear power plant. On July 13, 1999, welders were removing and cutting apart unused tanks in the waste evaporator feed tank room. While they were cutting a hole in a concentrator tank to characterize what remained inside the tank, their torch ignited a stainless steel mesh filter that was mounted inside the tank. The filter, which contained resin fines, ignited and smoldered. Fire brigade members extinguished the fire with a water extinguisher. (NRC Event Number 35916)

NFS has reported cutting and welding events in several Weekly Summaries. Following are some examples.

- Weekly Summary 97-45 reported that personnel at a commercial nuclear hot-cell facility reported a small fire in a flexible exhaust duct. Facility personnel believed the fire started when a piece of hot slag fell on the duct during the cutting of some steel plates being removed from a decommissioned hot cell. A fire watch extinguished the fire and was later hospitalized overnight for smoke inhalation. There was no release of radioactivity to the environment and no damage to the facility. (NRC Event Number 33204)

- Weekly Summary 97-40 reported that a safety engineer at the Savannah River Site observed several safety violations by subcontract welders during two welding operations and stopped them. The violations included fire watch violations, failure to use proper protective equipment, and combustible materials in the immediate area. Corrective actions required the subcontract personnel to review (1) requirements for preparing a work site prior to welding, (2) requirements for fire extinguishers at the work site while welding, and (3) fire watch roles and responsibilities. (ORPS Report SR--WSRC-RMAT-1997-0009)

- Weekly Summary 97-11 reported that a welder at the Oak Ridge K-25 Site was fatally burned during a cutting activity when two layers of his anti-contamination clothing and coveralls caught fire, engulfing him in flames. All of the clothing was cotton. A DOE Type A accident investigation determined that sparks or molten metal (slag) from the cutting operation ignited his clothing. (*Type A Accident Investigation Board Report on the February 13, 1997, Welding/Cutting Fatality at the K-33 Building, K-25 Site Oak Ridge, Tennessee*, and ORPS Report ORO--LMES-K25GENLAN-1997-0001)

These events illustrate the potential dangers associated with welding, cutting, and grinding activities. These activities pose safety and health hazards to workers under any circumstances, but they pose unique hazards to facility personnel performing decontamination and decommissioning activities. Fire prevention is an important consideration for these operations. Open flames, electric arcs, hot slag, sparks, and metal spatter are ready sources of ignition. Sparks from cutting, particularly oxyfuel gas cutting, are generally more hazardous than those from welding because the sparks are more numerous and travel greater distances because they are propelled by the oxygen or air stream used in the cutting process. Isolation or protection of combustibles is essential, for they may be exposed to sparks that fall through holes, cracks, or other openings. If those sparks retain heat for a sufficient time, they might ignite combustibles.

Managers at DOE facilities undergoing deactivation need to ensure that vendors and subcontractors understand local work control practices and the importance of following safety requirements. Several publications provide guidance on welding and cutting safety and on reducing fire hazards. The following publications contain many general and specific recommendations and should be consulted by supervisors of welding and cutting operations.

- DOE/EM-0142P, *Decommissioning Handbook*, March 1994, DOE Office of Environmental Restoration, provides requirements for worker protection during decontamination and decommissioning activities. It states that worker protection is an important element of any project. The handbook divides worker protection issues into three categories: (1) protection from radiation, (2) protection from toxic and hazardous materials, and (3) protection from traditional industrial safety hazards. It further states that DOE decommissioning activities may produce a combination of hazards not commonly encountered elsewhere (such as industrial safety hazards and radiological hazards) and lists OSHA regulations that apply to decommissioning, as well as key elements of a health and safety program. Section 12 of the handbook states that extra precautions are required for worker safety because hazards in the facility may be unknown and many activities are infrequently performed.

- DOE/EH-0196, Bulletin 97-3, *"Fire Prevention Measures for Cutting, Welding, and Related Activities,"* describes the fire protection measures necessary for those activities. Guidelines outlined in the bulletin include provisions for (1) management commitments, (2) job safety analysis, (3) permits, (4) isolation/protection of combustibles, (5) personnel protective equipment, (6) dedicated fire watches, (7) manual fire-fighting equipment, (8) emergency services, (9) site-specific hot work policies and procedures, and (10) information sharing.

- 29 CFR 1910.252, *General Requirements*, states that "cutting or welding shall be permitted only in areas that are or have been made fire safe." Section (a)(2)(vii) requires relocating combustible materials at least 35 ft from the work site. Where relocation is impracticable, combustibles shall be protected with flameproofed covers or otherwise shielded with metal or asbestos guards or curtains. Subpart I, Appendix B, "Non-mandatory Compliance Guidelines for Hazard Assessment and Personal Protective Equipment Selection," states that walk-downs of work areas should be performed to identify hazards before work begins.

- The National Fire Protection Association (NFPA) publications *Industrial Fire Hazards* and *Standard for Fire Prevention During Welding, Cutting, and Other Hotwork* provide guidance for the removal and protection of combustibles during welding and cutting activities.

- American National Standards Institute Standard Z49.1, *Safety in Welding, Cutting and Allied Processes*, covers all aspects of safety and health in the welding environment, emphasizing oxygen gas and arc welding processes. It contains information on protecting personnel and the general area, ventilation, fire prevention and protection, and confined spaces. Paragraph 6.2.2 requires a fire watch when combustible materials are closer than 35 ft to the point of operation. Paragraph 7.2.3 requires ducts used for local exhaust ventilation to be constructed of non-combustible materials and inspected to ensure proper function and to ensure that the internal surfaces are free of combustible residuals.

- The following two welding and cutting safety publications, as well as many others, can be ordered from the American Welding Society, 550 N.W. LeJeune Road, Miami, Florida 33126, by calling (800) 443-9353, or at http://www.aws.org: *Fire Safety in Welding and Cutting* outlines precautionary measures and safe practices to help avoid the hazards of fire and explosion; *Safe Practices* covers the basic elements of safety applicable to all welding, cutting, and related processes.

DOE/EH-0197, Safety Bulletin 97-3, can be obtained at http://tis.eh.doe.gov:80/docs/bull/links.html. OSHA regulations can be found at http://www.osha-slc.gov/OshStd_toc/OSHA_Std_toc.html. *Industrial Fire Hazards* and *Standard for Fire Prevention During Welding, Cutting, and Other Hotwork*, Standard 51B, can be obtained from the National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, Massachusetts 02269-9101. NFPA codes and standards can also be ordered at http://www.nfpa.org or by calling the NFPA at (800) 344-3555.

KEYWORDS: decontamination and decommissioning, fire safety, industrial safety, welding, work planning

FUNCTIONAL AREAS: Decontamination and Decommissioning, Industrial Safety, Work Planning

4. VISITOR DISCOVERS RADIOACTIVE CONTAMINATION IN MUSEUM DISPLAY

On July 7, 1999, at the Sandia National Laboratory—Albuquerque, a visitor to the National Atomic Museum discovered radioactive contamination on several lead bricks that were part of a nuclear medicine display in the museum. The visitor discovered the contamination when he picked up a radiation detector that was part of the display and scanned items in the display. When the scan reached the lead bricks, the detector indicated elevated readings. The visitor notified a Sandia employee of the event, who then notified the museum staff. Museum staff contacted radiation protection personnel, who roped the area off from the public and surveyed the lead bricks, the remainder of the display, and the floors and surfaces adjacent to the display. The surveys indicated that the contamination was limited to the lead bricks; 20 out of 29 were contaminated. The highest reading was 1,543 dpm/100 cm^2 removable and 462,800 dpm/100 cm^2 fixed. The contact dose rate was 0.1 mR/hr. This event is significant because the contaminated bricks were not properly controlled and were in an area accessible to the public. (ORPS Report ALO-KO-SNL-12000-1999-0001)

The next morning, while the museum was closed, radiation protection personnel conducted a detailed survey of the area. Analysis of two contaminated bricks indicated that the isotope of contamination was cesium-137. Radiation protection personnel determined the area to be in a safe configuration based on the fact that contamination was primarily fixed and limited to the lead bricks. They boxed up the bricks, labeled them as radioactive material, and placed them in proper storage.

Investigators determined that the display was on a four-year loan from a Veterans Administration hospital, but it is not known what the bricks had been used for. It is also not known whether the bricks were surveyed before they were shipped from the hospital or surveyed upon receipt and before use in the museum. They also determined that the items in the display were within reach (approximately 24 in) and that the visitor had leaned over an existing barrier. The visitor was familiar with the radiation detector and was showing others with him how the instrument works. Radiation protection personnel had surveyed all displays in the National Atomic Museum in July 1996, but the nuclear medicine display was set up in September 1997. The museum contains artifacts and informational displays on the nation's nuclear weapons development program. On display are numerous nuclear weapons casings and static displays on the development of nuclear technologies. The museum is operated by Sandia National Laboratory and is located at Kirtland Air Force Base.

OEWS engineers found other events in which museum display items or training items were contaminated, with some of them resulting in the spread of contamination. Some examples follow.

- On January 22, 1999, at the Oak Ridge Institute for Science and Education, a historic display item shattered within a display case and released its radioactive contents. The item was a 62-g piece of natural uranium metal fuel encased in a glass globe. The fuel was from the CP-1 reactor. The radiation safety officer decontaminated the interior of the display case to less than 100 dpm/100 cm^2 beta and 10 dpm/100 cm^2 alpha and placed the fuel in a source vault. Investigators believe that the glass globe shattered when trapped electrons discharged spontaneously. Radiation emitted from the fuel would have resulted in electrons becoming trapped within impurities in the glass. These electrons accumulated over time until the energy discharged and fractured the glass. (ORPS Report ORO--ORAU-ORISE-1999-0001)

- On April 11, 1995, at the Savannah River Site, K-Reactor personnel received a dummy fuel assembly, ordered from the University of Missouri for training purposes, which had fixed beta/gamma contamination of 150,000 dpm/100 cm^2. Radiological control operations personnel verified there was no spread of contamination. They notified the University of Missouri of the contamination on the dummy fuel assembly. Laboratory analysis determined that the primary contaminant was cobalt-60. K-Reactor personnel had ordered the dummy fuel assembly for use as a training mock-up in preparation for receiving spent research reactor fuel for storage. (Weekly Summary 95-15 and ORPS Report SR--WSRC-REACK-1995-0023)

- On February 14, 1992, at the Argonne National Laboratory—East, a temporary employee requested shipment of uranium ore from a museum for use in an instructional program about a radium dial painter program. The shipment contained about 1 kg of assorted rocks, which the employee removed from their container and stored on an uncontrolled shelf with no containment. The shelf became contaminated, and the dose rate from the aggregate sample was 1.3 mR/hr at 1 ft. Investigators determined that the employee opened the container and removed the samples without technical guidance and that he also failed to adequately convey his requirements to the museum. He intended to obtain only small amounts of material and assumed it would be enclosed in vials suitable for display. (ORPS Report CH-AA-ANLE-ANLEERD-1992-0001)

These events underscore the importance of ensuring that artifacts or display items have been surveyed for ionizing radiation or contamination before they are exhibited. If items containing small amounts of radioactivity must be used, it is important that they be properly controlled, labeled, and placed behind barriers sufficient to prevent the public from coming into contact with them. Also, devices used for training or demonstration, such as special tools, dummy equipment, or mock-ups, should be checked for the presence of radioactivity or contamination. It is important that instructors and trainees not be exposed to radiological hazards during training.

DOE/EH-0256T, *U.S. Department of Energy Radiological Control Manual*, states that DOE shall ensure that radiation exposures to its workers and the public and releases of radioactivity to the environment are maintained below regulatory limits and that deliberate efforts are taken to further reduce exposures and releases in accordance with a process that seeks to make any such exposures or releases as low as reasonably achievable.

KEYWORDS: contamination, radiation protection, radioactive material, visitor

FUNCTIONAL AREAS: Radiation Protection

OEAF FOLLOW-UP ACTIVITIES

1. WORKER INJURED DURING DEMOLITION CLEANUP

Weekly Summary 99-14 reported that a subcontractor ironworker apprentice at the Oak Ridge East Tennessee Technology Park was injured on March 26, 1999, when he was struck by a section of chain-link fence being removed by another worker operating a tracked excavator equipped with a hydraulic shearing/material-handling attachment (trackhoe/shear). The fence section, which was part of debris being removed following demolition work, hit the apprentice on the side and back of the head, causing him to bleed from scalp, ear, and facial lacerations. In May 1999, a Type B Accident Investigation Board completed its investigation of the accident. The Board identified the following root causes for the event: (1) subcontractor management failed to implement requirements for an adequate enhanced work planning process and task hazard analysis where hazardous changes had been introduced into existing work plans, (2) the prime contractor failed to apply a sufficiently formal set of controls to the contract with the subcontractor to cause the removal of hazards from the work site, and (3) DOE failed to develop an independent surveillance system to identify deficiencies in the prime and subcontractor enhanced work planning processes. The report, which contains valuable lessons for other DOE facilities, is summarized in this article. (DOE/ORO-2083, *Type B Accident Investigation Board Report on the Worker Injury at the BNFL, Inc. East Tennessee Technology Park Three-Building Decontamination and Decommissioning and Recycle Project Site*, May 1999, and ORPS Report ORO--BNFL-K33-1999-0001)

The apprentice and another ironworker were detaching bus bars and switches from air circuit breaker cabinets on top of a concrete slab 5¼ ft above ground level. The trackhoe/shear was pulling the bus bars from the cabinets and was also breaking concrete and removing metal from the slab. The workers' foreman told them to move some bus bars to clear the adjacent road. The ironworker then walked to the other end of the concrete slab and verified that the trackhoe/shear was approximately 40 ft away and facing 180 degrees away from them. Perceiving their egress route from the slab to be clear of the trackhoe, he climbed down from the slab to the street and the apprentice prepared to follow him. The trackhoe/shear was bundling a section of chain-link fence with a metal railing attached at each end to place it on a scrap metal pile located beside the road. After the fence and railing were bundled, the trackhoe/shear rotated to move the bundle to the scrap metal pile. The trailing end of the fence snagged an obstruction and approximately 30 ft of the fence plus the attached railing were pulled from the jaws of the shear. As the trackhoe/shear continued its rotation the fence was stretched and the trackhoe/shear operator noticed an increase in tension in the load. As the ironworker apprentice attempted to climb down off the slab, the fence pulled free from the obstruction before the trackhoe operator could stop the rotation and the trailing end flew over the boom and shear and struck the apprentice on the back of the head. The ironworker apprentice was knocked unconscious and fell face down onto the slab. Figure 1-1 shows a view of the accident scene.

Figure 1-1. View of Accident Scene with Worker Reenacting the Injured Ironworker[1]

The Accident Investigation Board determined that the work plans to remove the bus bars and perform the demolition were developed as independent tasks with task hazard analyses that prohibited other operations in close proximity or in adjoining areas. The Board also identified several contributing causes that may have increased the likelihood of the accident without individually having caused it. These contributing causes follow.

- **Procedures —** The procedure for the operation of the trackhoe/shear specifies “no person shall be in close proximity of the overall shear operation”. The procedure did not clearly define “close proximity” and allowed the ironworkers to be in an unsafe work zone. The procedure also did not require the presence of a spotter to assist the shear operator and did not require the use of in-cab communications between the operator and other personnel at the work site.

- **Worker Safety —** Failure to implement requirements for worker safety at the concrete slab meant there was no safe egress route from the slab and no safety barriers to delineate a safe work zone for the shear operation. The task hazard analysis for the shear demolition activity specifies “keep all persons not assigned to operation out of the area” and “place barricades to close off area”. There was no flagging or other safety barrier in place at the work site.

- **Task Hazard Analysis —** Failure to perform a task hazard analysis on the revisions to work resulting from the interface of the bus bar removal and shear operation work plans contributed to the accident.

- **Enhanced Work Planning —** The enhanced work planning (EWP) process for the work resulting from the interface of the two work plans was deficient in that it did not contain a step-by-step process to complete the work addressing methods of

[1] DOE/ORO-2083, *Type B Accident Investigation Board Report on the Worker Injury at the BNFL, Inc. East Tennessee Technology Park Three-Building Decontamination and Decommissioning and Recycle Project Site*, May 1999

accomplishment or a task hazard analysis. No controls to mitigate the hazards were produced for changes to the work plans. Control procedures commensurate with the original scope of the work plans were not applied to field changes resulting in the interface of these work plans.

- **Supervision/Management —** Supervision at the work site was less than adequate because the ironworkers' foreman did not address hazards caused by the interface of the two work plans. The ironworkers' managers failed to ensure that field changes at the work site were subject to controls as stringent as those applied to the original scope of work. They also failed to ensure that changes caused by the interface of elements from the two work plans were adequately addressed by revisions to the EWP process, as required by the subcontractor's quality assurance plan.

- **Worker Training —** There is no evidence the ironworkers were trained in the procedures and work plans required at the work site. This lack of training on job-specific procedures meant the workers were unaware of the hazard mitigations derived from the task hazard analysis in the work plans.

- **Worker Actions —** The ironworkers did not exercise stop-work authority for the work resulting from the interface of the work plans, did not realistically understand the hazards present at the work site, and could not communicate with the trackhoe/shear operator.

- **Communications —** There were no means at the worksite by which the ironworkers and the trackhoe/shear operator could exchange information about work site activities nor was there any system for reporting the accident or communicating during the emergency response.

This event underscores the importance of an integrated approach to safety that stresses clear goals and policies, individual and management accountability and ownership, implementation of requirements and procedures, and thorough and systematic management oversight. The responsibility for ensuring adequate planning and control of work activities resides with line management. Managers should ensure that work control processes are followed and facility practices are enforced. Personnel at DOE facilities should have a continually questioning attitude toward safety issues. Each individual is ultimately responsible for complying with rules to ensure personal safety. Facility managers should communicate the idea that safety is of prime importance and that all personnel must be committed to excellence and professionalism. Worker training should emphasize that changes in work methods or equipment, or any other deviation from an approved work plan, can introduce unforeseen hazards. In this event, elements of two different work plans were combined into one task without a task hazard analysis to mitigate the hazards of the new work plan. Changes to approved work methods and equipment must receive the same hazard analysis, review, and approval as the original work plan. Any change should entail a work stoppage and a thorough review of the potential hazards associated with the change. Workers should also be trained to stop work and report as-found conditions that are inconsistent with expected conditions.

DOE O 4330.4B, *Maintenance Management Program,* chapter 6, provides guidance for preparing and using procedures and other work-related documents that contain appropriate work directions. Section 6.2 states that deficient procedures and failure to follow procedures are major contributors to many significant and undesirable events. Section 7 provides guidance for planning, scheduling, and coordinating work activities. Section 8.3.6 states that nonfacility contractor and subcontractor personnel should be trained and qualified for the work they are to perform. It also states that subcontractor personnel should perform work to the same high standards expected of facility personnel and that subcontractor managers should be held accountable for the work performance of their personnel.

Integrated safety management information can be found at http://tis-nt.eh.doe.gov/ism. DOE technical standards are at http://www.doe.gov/html/techstds/standard/standard.html.

KEYWORDS: accident investigation, decontamination & decommissioning, industrial safety, injury, integrated safety management, stop work, work planning

FUNCTIONAL AREAS: Industrial Safety, Lessons Learned, Work Planning

2. OPERATING EXPERIENCE WEEKLY SUMMARY NOW AVAILABLE VIA E-MAIL

The Office of Nuclear and Facility Safety is now able to send a .pdf version of the OEWS directly to your e-mail. Here are just a few benefits you will see when you have an electronic copy sent "straight to your desktop."

- ***Faster delivery.*** The OEWS will arrive in a fraction of the time it takes to get your current hard-copy version.
- ***Full color.*** Pictures, drawings, and charts are in full color, so you can copy and paste them whenever you'd like.
- ***Easily reproducible.*** You can forward the electronic OEWS file to others who might be interested in reading it, or you can print out black-and-white or color copies at your computer for distribution.

To take advantage of the new electronic OEWS, all you need is an e-mail address and a .pdf reader, such as the Adobe Acrobat Reader. The Acrobat Reader is free and can be downloaded from the Adobe website at http://www.adobe.com/prodindex/acrobat/readstep.html.

Please fax or mail the Distribution Request Form in the back of this issue and check the "e-mail version" box provided. Or send your request, with "PLEASE ADD" in the subject line, to Christine Crow at ccrow@rpihq.com.

FINAL REPORT

This section of the OEWS discusses events filed as final reports in the ORPS. These events contain new or additional lessons learned that may be of interest to personnel within the DOE complex.

1. FORKLIFT MAST CONTACTS OVERHEAD COMMUNICATIONS CABLE

On April 19, 1999, at the Los Alamos National Laboratory (LANL), a forklift mast contacted a low-hanging communications cable while the operator positioned the vehicle for a lift. The force of the impact snapped a support cable and broke a utility pole cross-arm. When the utility pole swayed, a small amount of non-PCB oil leaked from the transformers on the poles. The communications line did not break and no personnel were injured. Workers repaired all of the damage by the following day. The forklift operator had failed to verify adequate clearance between the forklift mast and any overhead obstructions. This event is significant because a failure to observe safe operating practices for forklifts resulted in equipment damage and could have created other hazards to personnel health and safety. (ORPS Report ALO-LA-LANL-CHEMLASER-1999-0003; Weekly Summary 99-17)

Personnel from Advanced Chemical Diagnostics and Instrumentation (CST-1) were preparing to move an empty transportainer to a temporary location to perform modifications on it. CST-1 contacted a Business Support Services (BUS-8) representative to arrange to relocate the transportainer. The representative determined that the transportainer was too large to lift with any forklift available to BUS-8. He contacted the Materials Management group (BUS-4) and arranged for a bigger forklift and a licensed operator to perform the move.

On April 16, a CST-1 employee, the BUS-8 representative, and the BUS-4 forklift operator walked the site and planned the move. They noted potential obstructions that would need to be moved and planned to have two flagmen spot for the operator as he backed the forklift to remove the transportainer. The forklift was not on-site during the walk-down and was therefore not available for visual reference to the surroundings.

On April 19, the BUS-4 forklift operator drove a 15-ton Hyster forklift to the area where the transportainer was located. The mast of the forklift extended approximately 16 ft vertically with the forks still positioned near the ground. A 24-V communications line was suspended between two utility poles approximately 14 ft above ground level at its lowest point; the line extended diagonally across an open area in front of the transportainer. The two utility poles also supported a 110-V electrical line suspended at approximately 17 ft and a 13.2-kV line at 28 ft above the ground. Before checking in with the BUS-8 representative, the operator began to position the forklift for the transportainer lift. As he approached the transportainer, watching the forks at ground level, the 16-ft forklift mast struck the communications cable, breaking a support cable and a cross-arm on the adjacent utility pole.

Investigators determined the direct cause of the occurrence was personnel error (inattention to detail), because the forklift operator did not notice that the height of the mast exceeded the height at which the lines were suspended above the ground. They also determined the contributing cause of the occurrence was a design problem (inadequate work environment), because the forklift was a larger model than usually used by BUS-4 and was of a newer design, which has a higher mast than older vehicles. Investigators determined the root cause of the occurrence was a procedure problem (defective or inadequate procedure), because the operator did not stop to check in with facility personnel before starting the job, which was classified as non-facility work. This occurrence demonstrated that forklift operations at non-routine sites may require more formalized interaction with facility personnel to ensure the operator is adequately informed of the site's potential hazards.

LANL developed the following corrective actions in response to this occurrence.

- BUS-4 will place a job aid or sign on the instrument panel of all forklifts exceeding 10-ton capacity to alert licensed operators to the minimum and maximum height of the mast when the forklift is operating.

- BUS-4 will develop a hazard analysis checklist for all operators of heavy equipment. The checklist will include reminders to check for potential obstacles and hazards, to evaluate the load, to obtain site-specific information, and to interact with site personnel.

- CST-25 placed a sign at the entrance to the technical area warning of low-hanging wires.

- BUS-4 notified ES&H Training (ESH-13) and Industrial Hygiene and Safety (ESH-5) to include this occurrence report in their forklift training programs.

NFS has reported other events in the Weekly Summary that involved forklifts striking overhead cables and other obstructions. Some examples follow.

- Weekly Summary 98-48 reported that a fork truck mast contacted an overhead 480-V bus duct. The fork truck driver was moving supplies with the mast extended at the time of the incident. A nearby worker saw an electrical arc come from the bus duct to an adjoining piece of unistrut. The contact between the mast and the duct did not injure the driver or damage any equipment. Investigators determined that the direct and root cause of this occurrence was personnel error/inattention to detail by the fork truck driver. He failed to notice the height of the duct relative to the height of the mast and he failed to have a spotter assigned to direct the fork truck operation. Facility managers briefed workers on the incident and informed them of the hazards of fork truck/lift operations and of the need for spotters. (ORPS Report No. RFO--KHLL-NONPUOPS2-1998-0009)

- Weekly Summary 96-46 reported that an operator at the Idaho National Engineering Laboratory backed a forklift into a 480-V power line and a 208-V overhead power bundle with the forklift mast raised. Investigators determined that the forklift operator failed to use a spotter and failed to inspect the overhead area around the work location. Corrective actions included installing concrete barriers to prevent vehicle access near the power lines, adding postings for other overhead obstructions, and requiring area walk-downs to identify potential hazards. (ORPS Report ID--LITC-PBF-1996-0001)

These occurrences demonstrate the importance of pre-job planning and hazard analysis when preparing to use forklifts and fork trucks to move material or equipment. Careful attention should be paid to overhead hazards and obstacles when planning the route to be traveled by the specific forklift being used on the job. Operators should know the height of overhead obstructions relative to the maximum and minimum height of the job-specific forklift mast and the material or equipment being carried. Operators should deploy spotters during the lift. The operator and the spotters should be continuously alert to clearances between the forklift mast, the lifted equipment, and any overhead obstacles

KEYWORDS: communications, forklift, inspection, overhead

FUNCTIONAL AREAS: Industrial Safety, Materials Handling/Storage, Work Planning